RIVADA
NETWORKS

DELIVERING INNOVATION

E-LBS Brief to FCC
December 9th, 2014

E-LBS Agenda

Intro
What is E-LBS
IPR
E-LBS benefits
Sensor Fusion
Logic and Algorithm
Current Activities

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N E T W O R K S

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E-LBS

- Rivada Networks proposes a novel approach for improving the location position accuracy and confidence of wireless UEs in a process called enhanced location based service (E-LBS).

- E-LBS provides enhanced location information to mobile devices.
  - Works with or without GPS

- Enhanced Location Based Service (E-LBS) is IPR owned by Rivada Research LLC

Intellectual Property

- We have been awarded the Location Based Service (LBS) patent (US 8,787,944)
  - All 39 claims allowed by USPTO
  - World Patent Organization also agrees with all 39 claims
- *Filed other related LBS patents*
  - US Patent Application (14/293,056)
- Nine (9) International Patents applied for in the following countries using Prosecution Patent Highway
  - S Korea and Australia – allowed
  - Canada, China, Japan, Mexico, European Union (EU), India, Russia

E-LBS

- ## The solution is simple and elegant

If a mobile device cannot connect to the GPS satellites, then the mobile determines its location by learning the location of other mobiles nearby

E-LBS Benefits

- ## The solution has many benefits

  - Complements, does not replace, existing location based systems – co-existence is easy
  - Significantly improves location position accuracy and confidence especially in difficult coverage locations
  - Implemented in mobile device software only – no need for cooperation from network providers
  - Can easily become a library function that can be accessed by all location based applications

E-LBS   Advantages

- E-LBS does not require new hardware or software to be deployed by wireless operators.
- E-LBS is an API that can be implemented on a mobile device as a library function using the inherent capability of the device itself.
- Specifically E-LBS can be implemented using the OS from Apple, Android, RIM or Microsoft to mention some of the more prevalent operating systems.

E-LBS   Sensor Fusion

•E-LBS utilizes the concept of sensor fusion where a collaborative approach is used by the sensor suite on the mobile device.

•E-LBS uses both a reactive and proactive aspects taking the best of both approaches to enhance location accuracy and precision.

•Where GPS is used to help identify the initial positional fix, if available and is augmented through the use of Dead Reckoning and a hybrid trilateration method of position determination with utilizes both network and terminal based positioning.

•With E-LBS the mobile device is actively involved with the position calculations either with or without the support of the network devices.

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E-LBS   Sensor Fusion

- E-LBS utilizes several enhancements and are implemented depending on the situation the mobile device is presented to
- E-LBS involves the utilization of the sensors in the mobile device which are capable of providing heading, orientation distance traveled and velocity which will be provided by accelerometer, gyros, magnetic compass, altimeters and odometers as part of the sensor array in the mobile device
- The use of all internal sensors for positioning accuracy and confidence improvements is essential. The sensors will not act as an individual sensor but as a collective team. Therefore the use of multiple sensors, which do not rely on RF propagation characteristic, will provide an improvement to positional determination.
- With the E-LBS sensor fusion techniques the sharing of positional location telemetry including sensor data indicating relative movement of the individual mobile device enables these temporal readings to assist in the location estimate either with external assistance or dead reckoning

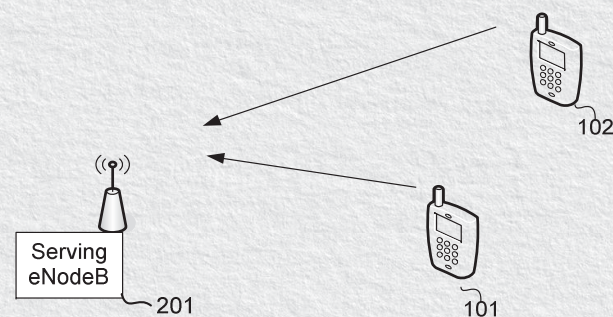12/9/2014

E-LBS   Simplified Overview
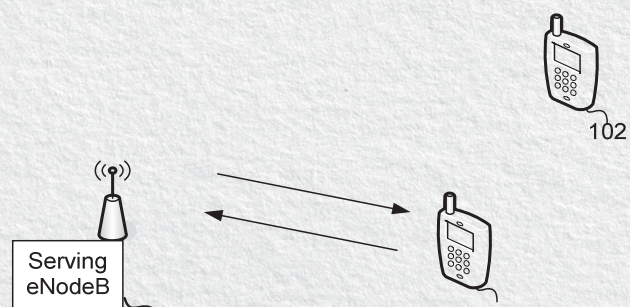
(1) Ue 101 Acquires Network
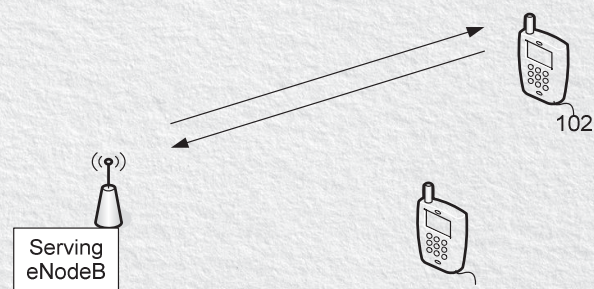
(2) Ue 102 Acquires Network
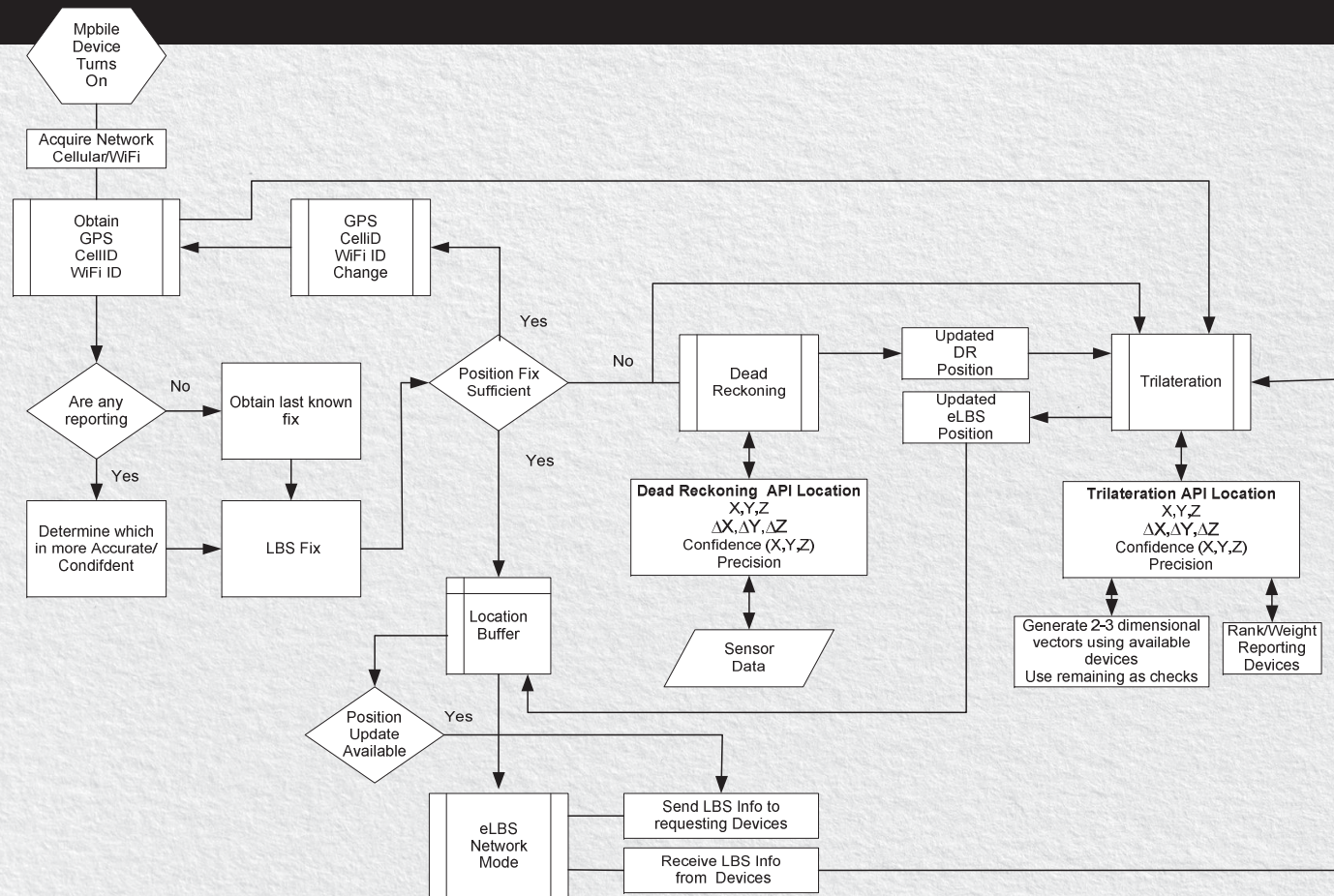
(3) Ue 101 and 102 share Location Information

(4) Ue 101 and 102 report updated Location Information
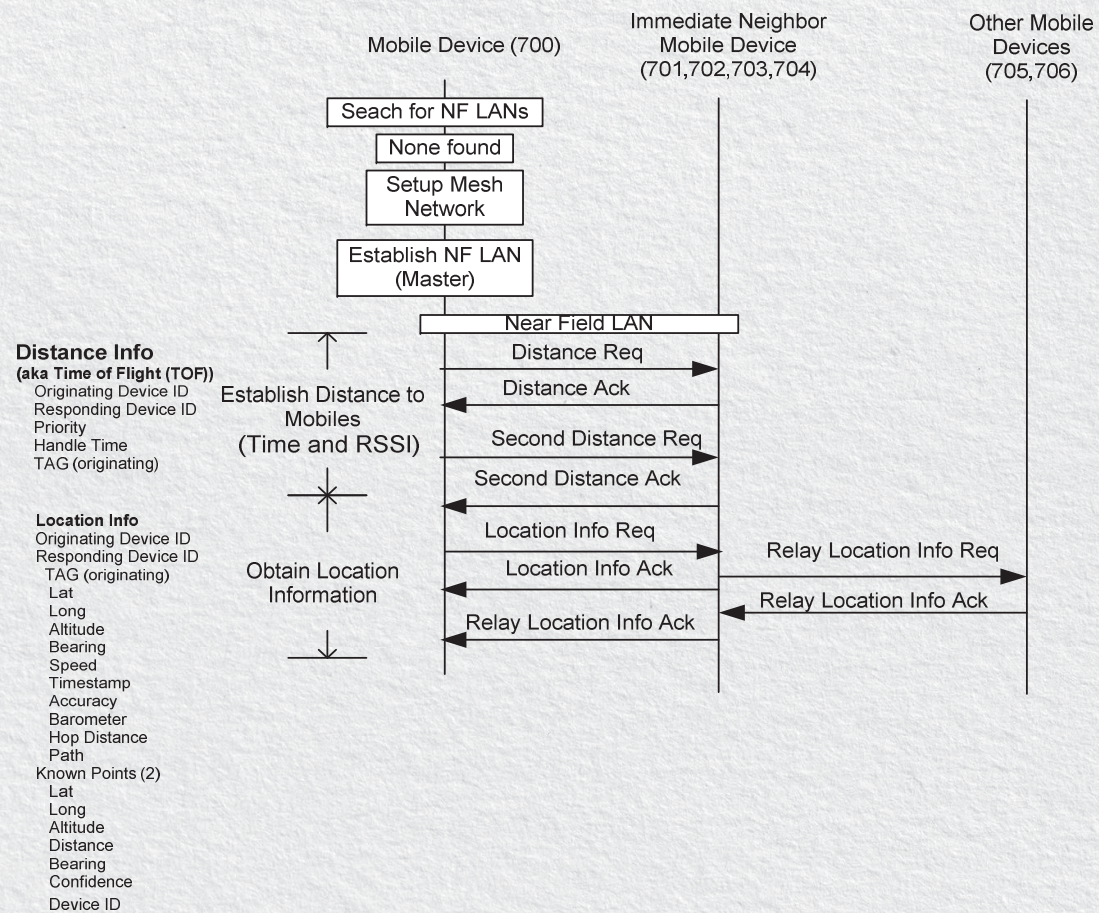
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E-LBS Algorithm

The E-LBS algorithm performs the following functions

1. Mobile device performs its own positional fix based on mobile data information received
2. Provides the initial location of the Mobile Device
3. Shares its location information with other grouped mobile devices
4. Positional data updated or confirmed with Dead Reckoning updates to enhance positional accuracy
5. Provides updated positional information to network for improved positional fix
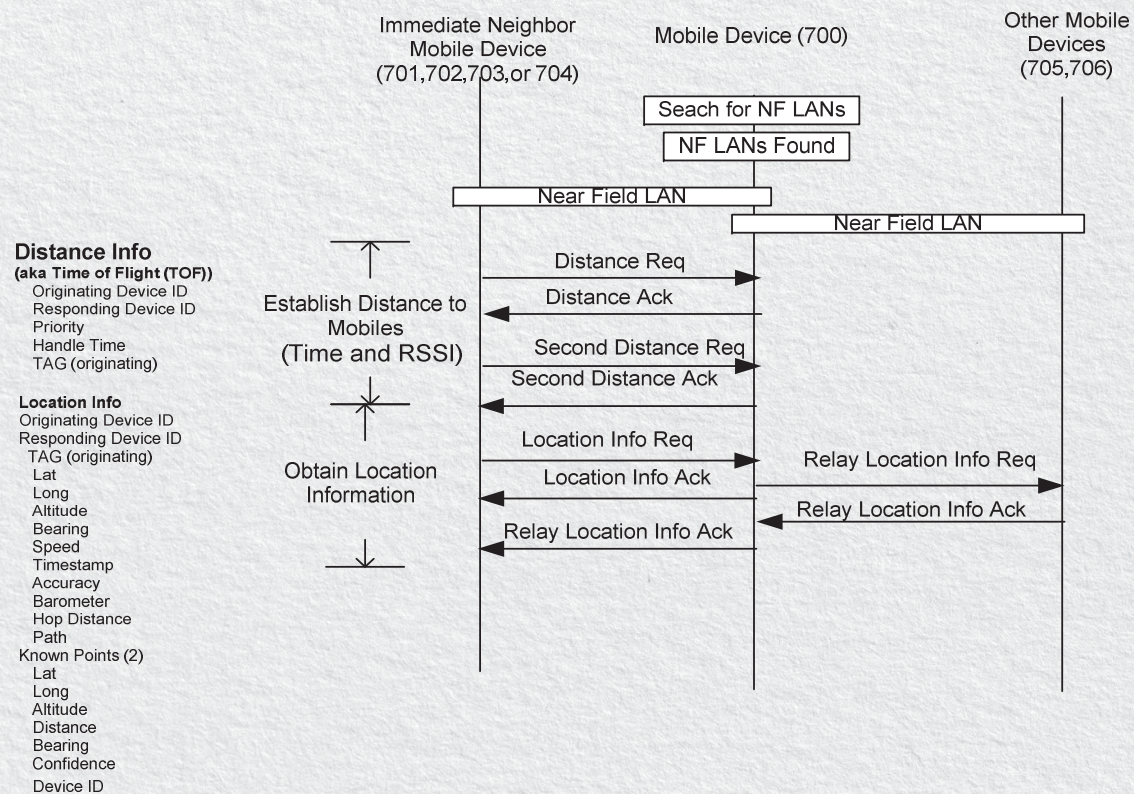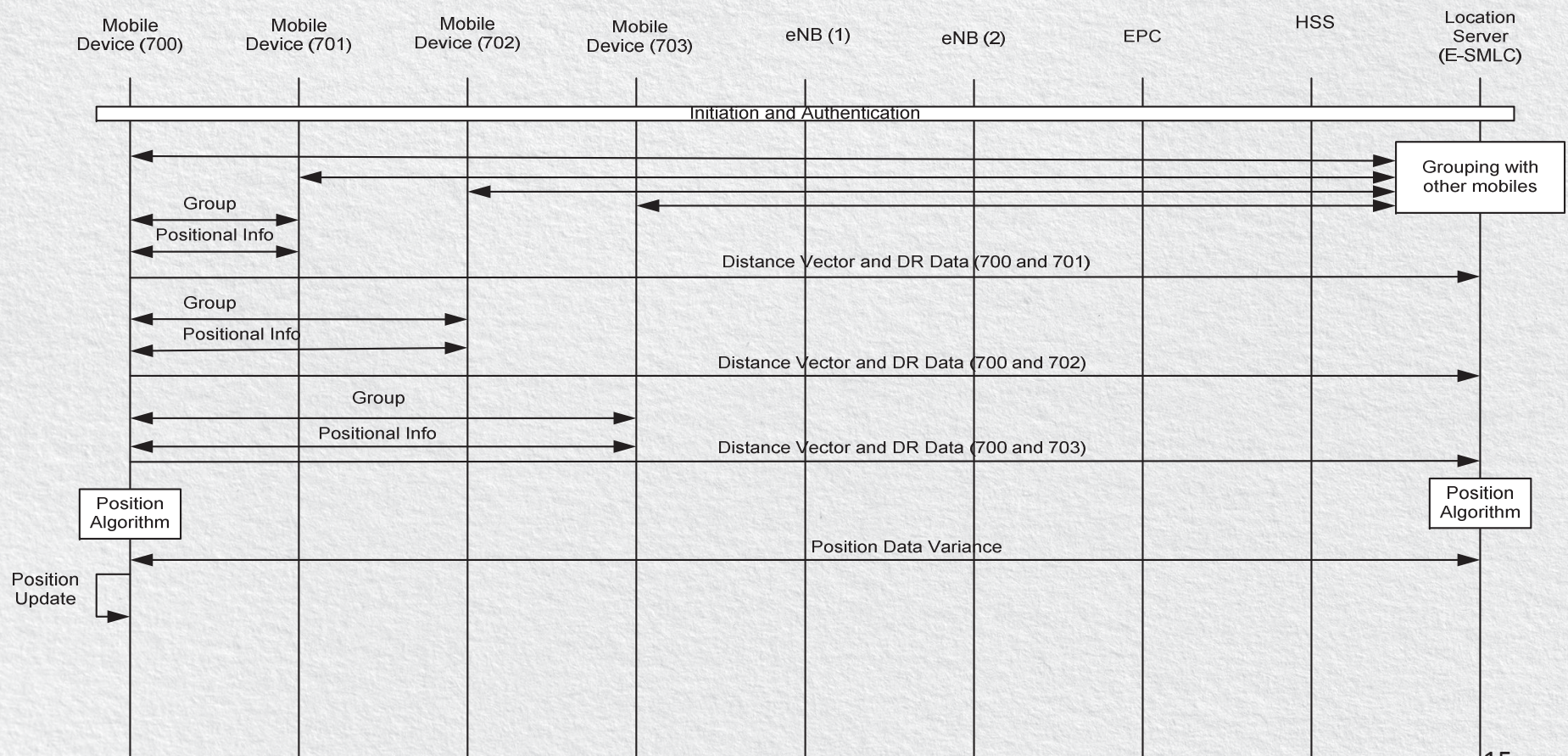6. Enables priority for E911 positional fix

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E-LBS   Logic Flow

E-LBS   Network Mode (master)

E-LBS   Network Mode (slave)

Immediate Neighbor
Mobile Device
(701,702,703,or 704)

Mobile Device (700)

Other Mobile
Devices
(705,706)

Seach for NF LANs

NF LANs Found

Near Field LAN

Near Field LAN

Distance Info
(aka Time of Flight (TOF))
   Originating Device ID
   Responding Device ID
   Priority
   Handle Time
   TAG (originating)

Location Info
Originating Device ID
Responding Device ID
   TAG (originating)
   Lat
   Long
   Altitude
   Bearing
   Speed
   Timestamp
   Accuracy
   Barometer
   Hop Distance
   Path
Known Points (2)
   Lat
   Long
   Altitude
   Distance
   Bearing
   Confidence
   Device ID

Establish Distance to
Mobiles
(Time and RSSI)

Obtain Location
Information

Distance Req

Distance Ack

Second Distance Req

Second Distance Ack

Location Info Req

Relay Location Info Req

Location Info Ack

Relay Location Info Ack

Relay Location Info Ack

E-LBS   Network Assist

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E-LBS   Current Activities

- Currently developing POC using Android and iOS
- Common core algorithm (OS independent)
- POC April 2015

E-LBS

Thank -You